

66th International Astronautical Congress 2015

MATERIALS AND STRUCTURES SYMPOSIUM (C2)

Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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DESIGN AND ANALYSIS OF A COMPOSITE SANDWICH SOLAR ARRAY STRUCTURE FOR THE
EU:CROPIS COMPACT SATELLITE WITH AS FEW RELEASE MECHANISMS AS POSSIBLE

Abstract

The design of solar array structures is globally driven by the stiffness and the mass per area with respect to the eigenfrequencies. While the light weight requirement for spacecraft structures is obvious, the reasons behind the stiffness requirement are more intricate. On the one hand the eigenfrequencies of the deployed arrays must not be equal to those of the control loop in order for the attitude and orbit control system to work properly. On the other hand, the fixation in the stowed configuration has to withstand the launch loads without excessive deflection. Considering the latter fact, this paper presents the design and analysis of a composite sandwich solar array with internal local stiffeners. The purpose of this investigation is the development of a four single array configuration for the Eu:CROPIS (Euglena: Closed Regenerative Organic food Production In Space) compact satellite. The release mechanisms to be used are Frangibolts. A main design driver is the use of as few hold down and release mechanisms as possible. This approach is well founded due to the reduced complexity of the on board computer, the harness, its connections and the reduced power consumption for deployment during the critical detumbling phase after launch. A finite element model is used to calculate the deformations, stresses and strains of the solar array in different configurations. The number of hold down and release mechanisms as well as the layout of the array stiffeners is investigated. The hold down and pad forces are evaluated under launch loads to examine the different array configurations. Furthermore, experimental data is generated and compared with the FE-Analysis to verify the calculations. Finally a prototype solar array based on the investigation is produced and tested on a test rig comparable to the satellite setup.